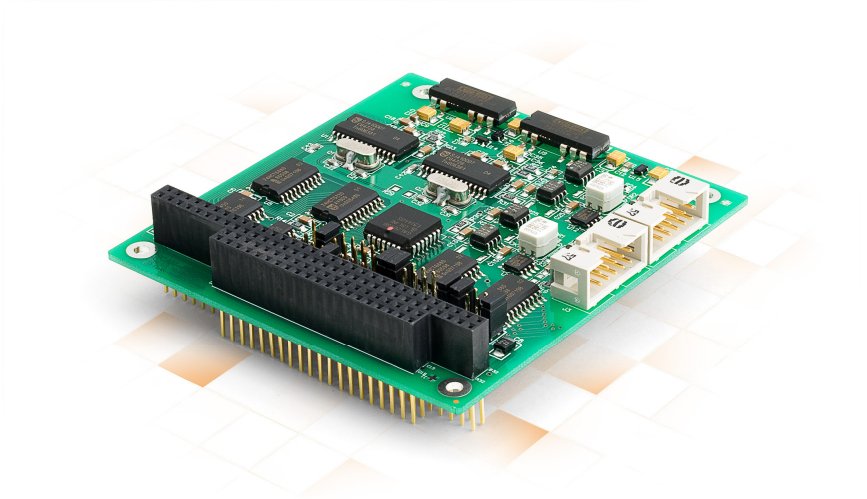
PCAN-PC/104

CAN Interface for PC/104

User Manual v2.2.3



PEAK System

Products taken into account

Product Name	Model	Part number
PCAN-PC/104 Single Channel	One CAN channel	IPEH-002054
PCAN-PC/104 Dual Channel	Two CAN channels	IPEH-002055
PCAN-PC/104 Single Channel opto-decoupled	One CAN channel, galvanic isolation for CAN connection	IPEH-002056
PCAN-PC/104 Dual Channel opto-decoupled	Two CAN channels, galvanic isolation for CAN connections	IPEH-002057

The cover picture shows the product PCAN-PC/104 Dual Channel opto-decoupled. Other product models have an identical form factor but vary in equipment.

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PEAK-System Technik GmbH
Otto-Roehm-Strasse 69
64293 Darmstadt
Germany

Phone: +49 (0)6151 8173-20
Fax: +49 (0)6151 8173-29

www.peak-system.com
info@peak-system.com

Document version 2.2.3 (2013-03-20)

Contents

1 Introduction 5

1.1 Properties at a Glance 5

1.2 System Requirements 6

1.3 Scope of Supply 7

2 Installing and Configuring the Software and the Card 8

2.1 Configuring the Card 8

2.1.1 Interrupt 9

2.1.2 I/O Address Range 10

2.2 Installing the Software and the Card 12

2.3 Modifying the Computer's BIOS Settings 13

2.3.1 Indicating Used Interrupts 14

2.3.2 Deactivating the APIC Mode 14

3 Connecting the CAN Bus 16

3.1 D-Sub Connector 16

3.2 Supplying External Devices via the CAN Connector 18

3.3 Cabling 20

3.3.1 Termination 20

3.3.2 Example of a Connection 20

3.3.3 Maximum Bus Length 21

4 Using the Software 22

4.1 PCAN-View for Windows 22

4.1.1 Receive/Transmit Tab 25

4.1.2 Trace Tab 27

4.1.3 Status Bar 28

4.2 Linking Own Programs with PCAN-Basic 29

4.2.1 Features of PCAN-Basic 30

4.2.2 Principle Description of the API 31
4.2.3 Notes about the License 32

5 Technical Specifications PCAN-PC/104 33

Appendix A CE Certificate 35

Appendix B Dimension Drawing 36

Appendix C Quick Reference 37

1 Introduction

The PCAN-PC/104 is a compact PC/104 CAN card which allows the networking of one or two CAN busses to a PC/104 system. Device drivers and programming interfaces exist for different operating systems, so programs can easily access a connected CAN bus.

Tip: At the end of this manual (Appendix C) you can find a Quick Reference with brief information about the installation and operation of the PCAN-PC/104 card.

1.1 Properties at a Glance

- Form factor PC/104
- Multiple PC/104 cards can be operated in parallel (interrupt sharing)
- 14 port and 8 interrupt addresses are available for configuration using jumpers
- 1 or 2 High-speed CAN channels (ISO 11898-2)
- Compliant with CAN specifications 2.0A (11-bit ID) and 2.0B (29-bit ID)
- NXP CAN controller SJA1000, 16 MHz clock frequency
- NXP CAN transceiver PCA82C251
- CAN bus connection via D-Sub, 9-pin (in accordance with CiA® 102)
- Bit rates up to 1 Mbit/s
- Galvanic isolation up to 500 V for the CAN interface (only opto-decoupled models), separate for each CAN channel

- 5-Volt power supply at the CAN connector connectible by solder jumpers, e.g. for external bus converter
- Extended operating temperature range of -40 to +85 °C (-40 to +185 °F)

Note: This manual describes the use of the PCAN-PC/104 card with **Windows**. You can find device drivers for **Linux** and the corresponding application information on the provided DVD in the directory branch `Develop` and on our website under www.peak-system.com/linux.

1.2 System Requirements

- PC/104 stack with ISA bus (according to the PC/104 specification)
- Operating system Windows 8, 7, Vista, XP (32-bit),
  or Windows CE 6.x (x86 and ARMv4 processor support),
  or Linux (32-bit)

1.3 Scope of Supply

- PCAN-PC/104 card
- Slot bracket with D-Sub connector(s) for the CAN bus connection
- Device drivers for Windows 8, 7, Vista, XP (32-bit) and Linux (32-bit)
- Device driver for Windows CE 6.x (x86 and ARMv4 processor support)
- PCAN-View CAN monitor for Windows 8, 7, Vista, XP (32/64-bit)
- PCAN-View CAN monitor for DOS
- PCAN-Basic programming interface consisting of an interface DLL, examples, and header files for all common programming languages
- Manual in PDF format

2 Installing and Configuring the Software and the Card

This chapter covers the configuration, the software setup for the PCAN-PC/104 card under Windows, and the card installation in the computer.

2.1 Configuring the Card

Before installing the PCAN-PC/104 card into the computer you may need to configure it. For each CAN channel an interrupt (IRQ) and an I/O address range is set for operation in the computer.

At delivery the PCAN-PC/104 card has the following default settings:

CAN Channel	IRQ	I/O Address Range	Comment
1	10	300h – 31Fh	
2	5	320h – 33Fh	Dual Channel model only

Tip: If the given resources are not permanently allocated by other devices, you can skip the configuration and directly continue with the following manual section 2.2 on page 12.

For a configuration differing from the default settings you need to set jumpers on the PCAN-PC/104 PCB according to the following explanations.

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PCAN-PC/104 card. Take precautions to avoid ESD when handling the card.

2.1.1 Interrupt

An interrupt (IRQ) must be assigned to each CAN channel. This is done with a single jumper on jumper field JP1 for CAN channel 1 and jumper field JP2 for CAN channel 2 (latter refers only to the Dual Channel model). The PCAN-PC/104 card supports the interrupts 3, 4, 5, 7, 10, 11, 12, and 15. The default setting at delivery for CAN channel 1 is interrupt 10, for CAN channel 2 interrupt 5.

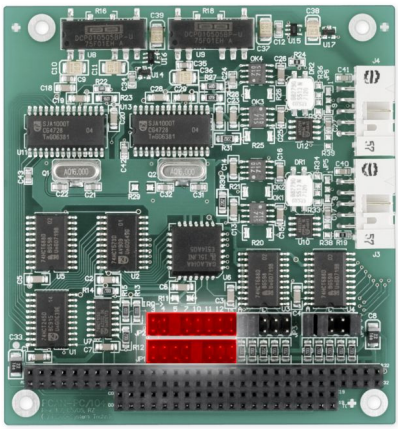

Figure 1: Position of the jumper fields for setting the interrupts,
JP1 for CAN channel 1 (lower jumper field),
JP2 for CAN channel 2 (upper jumper field,
Dual Channel model only)

It is possible to share the same interrupt between two existing CAN channels. Therefore you can configure the same interrupt when using two PCAN-PC/104 cards in the same computer.

Tip: We suggest to configure different interrupts as long as resources allow it and use interrupt sharing only if this is not the case.

2.1.2 I/O Address Range

Each CAN channel must be assigned to an unique I/O address range in the computer. An address space from 200h up to 39Fh and 3E0h to 3FFh (h = hexadecimal) is available. PCAN-PC/104 uses 32 addresses beginning from the configured base address. The configuration is done on jumper field JP3 for CAN channel 1 and jumper field JP4 for CAN channel 2 (latter refers only to the Dual Channel model). One or several jumpers are needed for each jumper field.

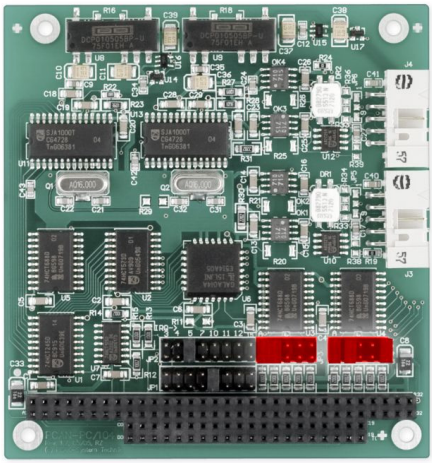

Figure 2: Position of the jumper fields for setting the I/O base addresses,
JP3 for CAN channel 1 (left jumper field),
JP4 for CAN channel 2 (right jumper field, Dual Channel model only)

The following table shows the possible settings. The X stands for a set jumper. The default settings at delivery for CAN channels 1 and 2 are highlighted.

Continued on the next page

Jumper field JP3/JP4					I/O address range
A	B	C	D	E	
X					200h – 21Fh
X				X	220h – 23Fh
X			X		240h – 25Fh
X			X	X	260h – 27Fh
X		X			280h – 29Fh
X		X		X	2A0h – 2BFh
X		X	X		2C0h – 2DFh
X		X	X	X	2E0h – 2FFh
X	X				300h – 31Fh
X	X			X	320h – 33Fh
X	X		X		340h – 35Fh
X	X		X	X	360h – 37Fh
X	X	X			380h – 39Fh
X	X	X	X	X	3E0h – 3FFh

2.2 Installing the Software and the Card

Setup the driver before inserting the card.

- Do the following to install the driver:

1. Make sure that you are logged in as user with administrator privileges (not needed for normal use of the card later on).
2. Insert the supplied DVD into the appropriate drive of the computer. Usually a navigation program appears a few moments later. If not, start the file `Intro.exe` from the root directory of the DVD.
3. On the page **English** > **Drivers** activate the entry **PCAN-ISA**.
4. Click on **Install now**. The setup program for the driver is executed.
5. Follow the instructions of the program.

Tip: If you do not want to install the CAN monitor PCAN-View for Windows onto the hard disk together with the driver, you have the option to start the program later directly from DVD without prior installation.

- Do the following to install the PCAN-PC/104 card in the computer:

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PCAN-PC/104 card. Take precautions to avoid ESD when handling the card.

Shut down the computer.

6. Disconnect the computer from the power supply.
7. Plug the PCAN-PC/104 card onto a PC/104 connector. For details refer to the documentation of the computer.

8. Interconnect the connector for each CAN channel on the PCAN-PC/104 card (see Figure 3) with the CAN connector of the slot bracket using the attached flat cable.

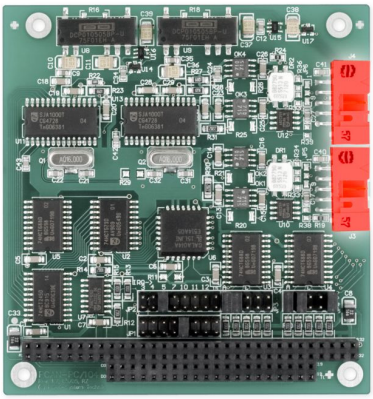

Figure 3: Connectors for the flat cables to the CAN connectors,
J3 for CAN channel one (lower position),
J4 for CAN channel 2 (upper position, Dual Channel model only)

9. Reconnect the power supply of the computer.

Note: Before switching on the computer, please follow the procedure for modifying the computer's BIOS settings described in the following section.

2.3 Modifying the Computer's BIOS Settings

To ensure a flawless operation of the PCAN-PC/104 card it is necessary that you adjust settings in the BIOS setup of the computer:

- Indicate used interrupts
- Deactivate the APIC mode

Note: Due to a diversity of existing BIOS setup versions for computers we cannot give detailed instructions here. Instead we indicate common setting names.

In order to know how to start the computer's BIOS setup please consult the corresponding documentation. Usually you can enter the BIOS setup by pressing the Del or F2 key shortly after switching on the computer.

2.3.1 Indicating Used Interrupts

By indicating the interrupts that are set on the PCAN-PC/104 card, you avoid that the corresponding resources are automatically assigned to other devices and that this results in conflicts.

In the BIOS setup itself you can often find the settings for the interrupts under a menu item containing the text “PnP”. For the interrupt(s) used by PCAN-PC/104 change the setting to “Reserved” or “Legacy ISA”.

2.3.2 Deactivating the APIC Mode

Note: Do not mix up APIC with ACPI.

The APIC mode is a certain type of interrupt management in a computer.

If the APIC mode is active in your computer, you must deactivate it so that the PCAN-PC/104 card can work properly with interrupts.

- Do the following to determine in Windows if the APIC mode is active:

  Open the Windows **Device Manager**.

  10. Select the menu entry **View** > **Resources by type**.

11. Open the branch of **Interrupt request (IRQ)**.

    If entries with interrupt numbers greater than 15 are listed, the APIC mode is active and you must deactivate it.

➡ Do the following to deactivate the APIC mode:

Important note: When you deactivate the APIC mode in the BIOS setup, it may happen that you must reinstall Windows afterwards, because it cannot start anymore due to the low-level setting.

Restart the computer and switch to the BIOS setup.

12. Search for the APIC setting and deactivate it.
13. Save the changes in the BIOS and quit the BIOS setup.
14. If Windows doesn't start properly, reinstall it or perform a repair installation.

3 Connecting the CAN Bus

3.1 D-Sub Connector

A High-speed CAN bus (ISO 11898-2) is connected to the 9-pin D-Sub connector. The pin assignment corresponds to the specification CiA® 102.

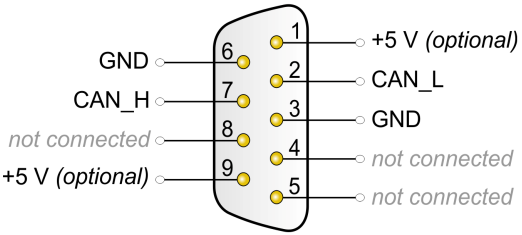

Figure 4: Pin assignment High-speed CAN
(view onto connector of the slot bracket)

With the pins 1 and 9 devices with low power consumption (e.g. an external bus converter) can be directly supplied via the CAN connector. At delivery these pins are not assigned. You can find a detailed description about the activation in the following section 3.2.

The pin assignment between the D-Sub port and the 10-pin connector on the PCAN-PC/104 card is as follows:

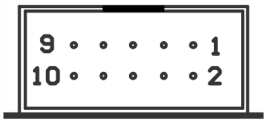

Figure 5: Numbering at the 10-pin connector

Pin	Assignment	Assignment D-Sub
1	+5 V (optional)	1
2	GND	6
3	CAN_L	2
4	CAN_H	7
5	GND	3
6	not connected	8
7	not connected	4
8	+5 V (optional)	9
9	not connected	5
10	not connected	

Tip: You can connect a CAN bus with a different transmission standard via a bus converter. PEAK-System offers different bus converter modules (e.g. PCAN-TJA1054 for a Low-speed CAN bus according to ISO 11898-3).

3.2 Supplying External Devices via the CAN Connector

You can route a 5-Volt supply to pin 1 and/or pin 9 of the CAN connector (independently for each CAN connector on the Dual Channel model) by setting solder jumpers on the PCAN-PC/104 card. Thus devices with low power consumption (e.g. a bus converter) can be directly supplied via the CAN connector.

When using this option the 5-Volt supply is connected to the power supply of the computer and is not fused separately. The opto-decoupled models of the card contain an interconnected DC/DC converter. Therefore the current output is limited to about 50 mA.

➡ Proceed as follows to activate the 5-Volt supply:

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PCAN-PC/104 card. Take precautions to avoid ESD when handling the card.

Set the solder jumpers on the PCAN-PC/104 card according to the desired settings. During this procedure take especially care not to produce unwanted short circuits on the card.

Figure 6 shows the positions of the solder fields on the PCAN-PC/104 card. The table below contains the possible settings.

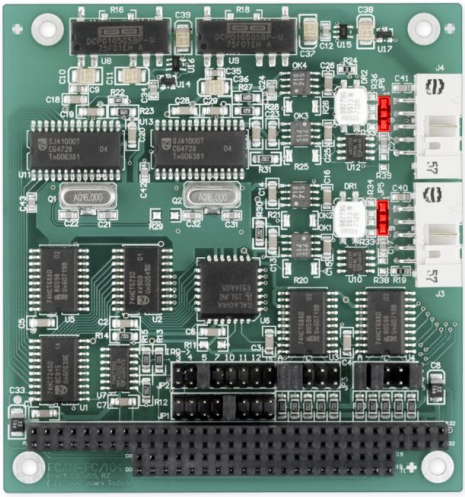

Figure 6: Position of the solder jumper fields for the 5-Volt supply
(JP5 lower position, JP6 upper position)

5-Volt supply →	None	Pin 1	Pin 9	Pin 1 + Pin 9
JP5 (CAN channel 1) / JP6 (CAN channel 2)				

Attention! Risk of short circuit! If the option described in this section is activated, you may only connect or disconnect CAN cables or peripheral systems (e.g. an external bus converter) to or from the PCAN-PC/104 card while the computer is de-energized.

3.3 Cabling

3.3.1 Termination

A High-speed CAN bus (ISO 11898-2) must be terminated on both ends with 120 Ohms. Otherwise, there are interfering signal reflections and the transceivers of the connected CAN nodes (CAN interface, control unit) will not work.

The PCAN-PC/104 card does not have an internal termination. Use the adapter on a terminated CAN bus.

3.3.2 Example of a Connection

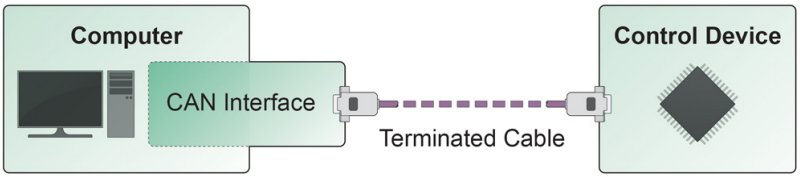

Figure 7: Simple CAN connection

In this example, the PCAN-PC/104 card is connected with a control unit by a cable that is terminated at both ends.

3.3.3 Maximum Bus Length

High-Speed-CAN networks may have bit rates of up to 1 Mbit/s. The maximum bus length is primarily depending on the bit rate.

The following table shows the maximum CAN bus length at different bit rates:

Bit rate	Bus length
1 Mbit/s	40 m
500 kbit/s	110 m
250 kbit/s	240 m
125 kbit/s	500 m
50 kbit/s	1.3 km
20 kbit/s	3.3 km
10 kbit/s	6.6 km
5 kbit/s	13.0 km

The listed values have been calculated on the basis of an idealized system and can differ from reality.

4 Using the Software

This chapter covers the provided software PCAN-View and the programming interface PCAN-Basic.

4.1 PCAN-View for Windows

PCAN-View for Windows is a simple CAN monitor for viewing, transmitting, and logging CAN messages.

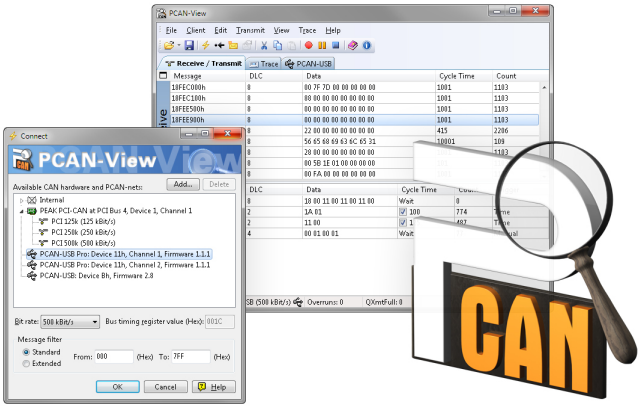

Figure 8: PCAN-View for Windows

Do the following to start and initialize PCAN-View:

1. If PCAN-View is already installed on the hard disk, open the Windows Start menu, go to **Programs** > **PCAN-Hardware**, and select the entry **PCAN-View**.

If you haven't installed PCAN-View together with the device driver, you can start the program directly from the supplied DVD. In the navigation program (`Intro.exe`) go to **English** > **Tools**, and under **PCAN-View for Windows** select the link **Start**.

The dialog box for selecting the CAN hardware and for setting the CAN parameters appears.

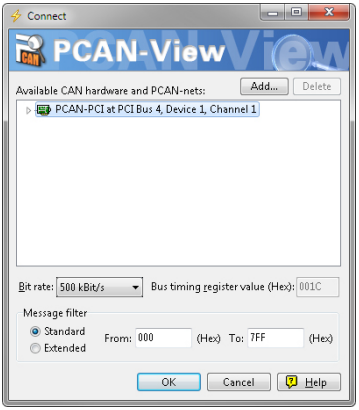

Figure 9: Selection of the CAN specific hardware and parameters

If there is no entry in the list **Available CAN hardware** (for example at the first program start), you need to add one:

Run PCAN-View with administrator privileges (Windows XP: user login with corresponding privileges, Windows Vista, 7 and 8: via the context menu of PCAN-View's Start menu entry).

2. Click on the **Add** button.

   The dialog box **Add CAN hardware** appears.

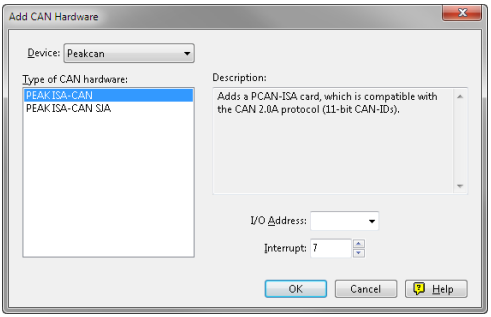

Figure 10: Selection of the hardware

3. Select the connected hardware and the operating mode from the list **Type of CAN hardware**, in this case **PEAK ISA-CAN SJA**.

4. Enter the **I/O Address** and the **Interrupt**, as they are set on the PCAN-PC/104 card (see section 2.1 *Configuring the* Card on page 8).

   Default setting on the card at delivery:

CAN Channel	IRQ	I/O Address Range	Comment
1	**10**	**300**h – 31Fh	
2	**5**	**320**h – 33Fh	Dual Channel model only

5. Confirm your input with **OK**.

6. From the list **Available CAN hardware** select the CAN channel to be used.

7. Select the **Bit rate** that is used by all nodes on the CAN bus.

8. Under **Filter settings** you can limit the range of CAN IDs to be received, either for standard frames (11-bit IDs) or for extended frames (29-bit IDs).

9. Finally confirm the settings in the dialog box with **OK**. The main window of PCAN-View appears (see Figure 11).

4.1.1 Receive/Transmit Tab

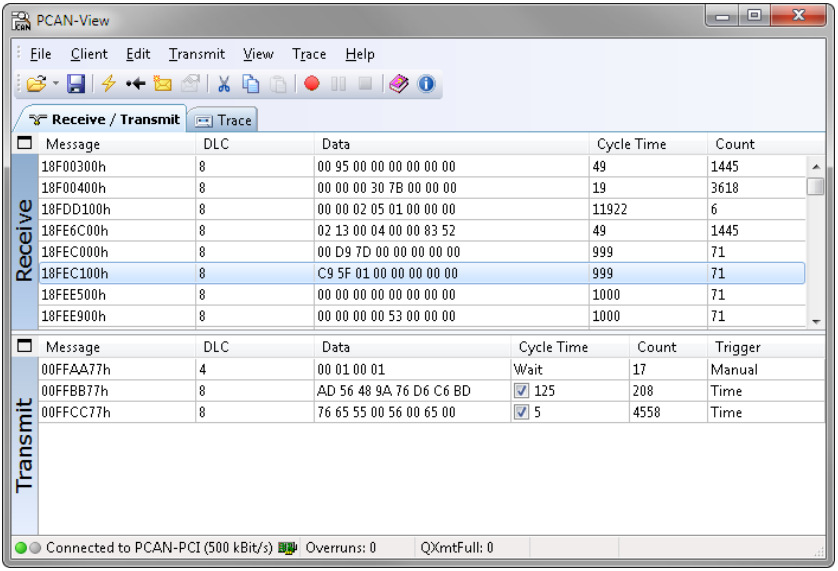

Figure 11: Receive/Transmit tab

The Receive/Transmit tab is the main element of PCAN-View. It contains two lists, one for received messages and one for the transmit messages. Representation of CAN data is in hexadecimal format.

- Do the following to transmit a CAN message with PCAN-View:

  Select the menu command **Transmit** > **New Message** (alternatively or Ins).

  The dialog box **New Transmit Message** is shown.

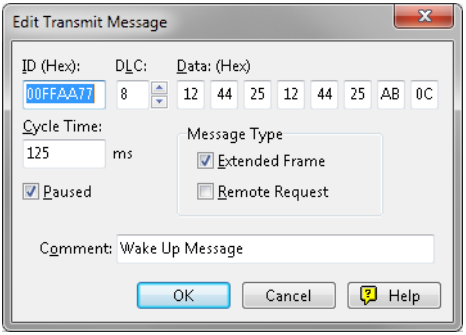

Figure 12: Dialog box New transmit message

10. Enter the ID and the data for the new CAN message.
11. The field **Cycle Time** indicates if the message shall be transmitted manually or periodically. If you want to transmit the message periodically, you must enter a value greater than 0. For a manual-only transmission enter 0.
12. Confirm the entries with **OK**.

    The created transmit message appears on the **Receive/Transmit** tab.
13. You trigger selected transmit messages manually with the menu command **Transmit** > **Send** (alternatively Space bar). The manual transmission for CAN messages being transmitted periodically is carried out additionally.

Tip: Using the menu command **File** > **Save** the current transmit messages can be saved to a list and loaded for reuse later on.

4.1.2 Trace Tab

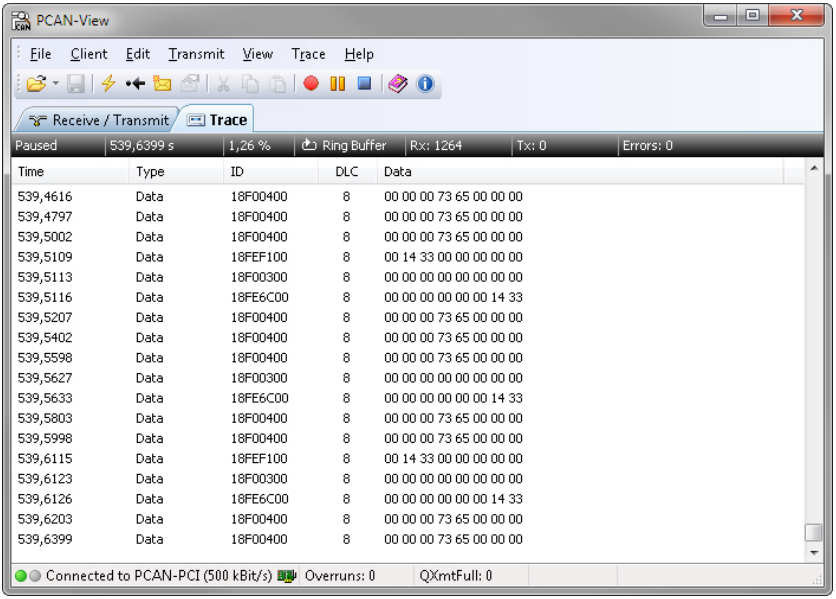

Figure 13: Trace tab

On the Trace tab the data tracer of PCAN-View is used for logging the communication on a CAN bus. During this process the CAN messages are cached in the working memory of the PC. Afterwards they can be saved to a file.

The tracer can be configured to run in linear or in ring buffer mode. In linear buffer mode the logging is stopped as soon as the buffer is filled completely. In ring buffer mode the oldest messages are overwritten by incoming ones.

4.1.3 Status Bar

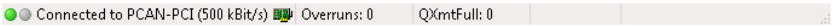

Figure 14: Display of the status bar

The status bar shows information about the current CAN connection, about error counters (Overruns, QXmtFull), and shows error messages.

You can find further information about the use of PCAN-View in the help which you can invoke in the program via the **Help** menu or with the F1 key.

4.2 Linking Own Programs with PCAN-Basic

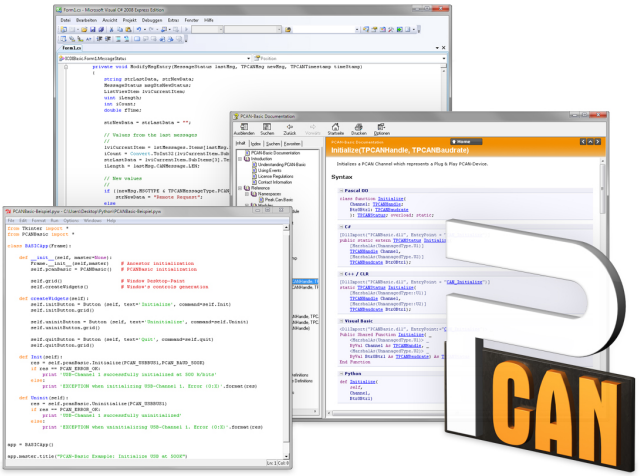

Figure 15: PCAN-Basic

On the provided DVD you can find files of the programming interface PCAN-Basic in the directory branch `Develop`. This API provides basic functions for linking own programs to CAN interfaces by PEAK-System and can be used for the following operating systems:

- Windows 8, 7, Vista, XP (32/64-bit)
- Windows CE 6.x (x86/ARMv4)

The API is designed for cross-platform use. Therefore software projects can easily ported between platforms with low efforts. PEAK-System has created examples for the following programming languages: C++, C#, C++/CLR, Visual Basic, Delphi, Python, and Java.

4.2.1 Features of PCAN-Basic

- Supports Windows 8, 7, Vista, XP (32/64-bit) and Windows CE 6.x operating system
- Multiple PEAK-System applications and your own can be operated on a physical CAN channel at the same time
- Use of a single DLL for all supported hardware types
- Use of up to 8 channels for each hardware unit (depending on the PEAK CAN interface used)
- Simple switching between channels of a PEAK CAN interface
- Driver-internal buffering of 32,768 messages per CAN channel
- Precision of time stamps on received messages up to 1 µs (depending on the PEAK CAN interface used)
- Access to specific hardware parameters, such as listen-only mode
- Notification of the application through Windows events when a message is received
- Extended system for debugging operations
- Multilingual debugging output
- Output language depends on operating system
- Debugging information can be defined individually

An overview of the API functions is located in the header files. You can find detailed information about the PCAN-Basic API on the provided DVD in the text and help files (file name extensions `.txt` and `.chm`).

4.2.2 Principle Description of the API

The PCAN-Basic API is the interface between the user application and device driver. In Windows operating systems this is a DLL (Dynamic Link Library).

The sequence of accessing the CAN interface is divided into three phases:

1. Initialization
2. Interaction
3. Completion

Initialization

A CAN channel must be initialized before using it. This is done by the simple call of the function `CAN_Initialize`. Depending on the type of the CAN hardware, up to eight CAN channels can be opened at the same time. After a successful initialization the CAN channel is ready for communication with the CAN hardware and the CAN bus. No further configuration steps are required.

Interaction

For receiving and transmitting CAN messages the functions `CAN_Read` and `CAN_Write` are available. Additional settings can be made, e.g. setting up message filters to confine to specific CAN IDs or setting the CAN controller to listen-only mode.

When receiving CAN messages, events are used for an automatic notification of an application (client). This offers the following advantages:

- The application no longer needs to check for received messages periodically (no polling).
- The response time at reception is reduced.

Completion

To end the communication the function `CAN_Uninitialize` is called in order to release the reserved resources for the CAN channel, among others. In addition the CAN channel is marked as "Free" and is available to other applications.

4.2.3 Notes about the License

Device drivers, the interface DLL, and further files needed for linking are property of the PEAK-System Technik GmbH and may be used only in connection with a hardware component purchased from PEAK-System or one of its partners. If a CAN hardware component of third-party suppliers should be compatible to one of PEAK-System, then you are not allowed to use or to pass on the driver software of PEAK-System.

If a third-party supplier develops software based on the PCAN-Basic and problems occur during the use of this software, consult the software provider.

5 Technical Specifications PCAN-PC/104

Connectors	
PC/104	ISA bus with 8 MHz clock rate, 16 bit bus width
CAN	D-Sub (m), 9 pins Pin assignment according to specification CiA® 102

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (standard format) and 2.0B (extended format)
Bit rates	5 kbit/s - 1 Mbit/s
Controller	NXP SJA1000
Transceiver	NXP PCA82C251
Galvanic isolation	PCAN-PC/104: none PCAN-PC/104 opto: up to 500 V, separate for each CAN channel
Supplying external devices	PCAN-PC/104: D-Sub pin 1/9; 5 V, max. 100 mA PCAN-PC/104 opto: D-Sub pin 1/9; 5 V, max. 50 mA Not assigned at delivery
Termination	none

Power supply		
Supply voltage	5 V	
Current consumption	PCAN-PC/104 Single Channel: PCAN-PC/104 Dual Channel: PCAN-PC/104 Single Channel opto: PCAN-PC/104 Dual Channel opto:	max. 150 mA max. 170 mA max. 210 mA max. 270 mA

Continued on the next page

Environment	
Operating temperature	-40 - +85 °C (-40 - +185 °F)
Temperature for storage and transport	-40 - +125 °C (-40 - +257 °F)
Relative humidity	15 - 90 %, not condensing
EMC	EN 55024:2011-09 EN 55022:2011-12 EC directive 2004/108/EG

Measures	
Size	96 x 91 x 24 mm (see also dimension drawing Appendix B on page 36)
Weight	PCAN-PC/104 Single Channel: 57 g PCAN-PC/104 Dual Channel: 63 g PCAN-PC/104 Single Channel opto: 59 g PCAN-PC/104 Dual Channel opto: 65 g

Appendix A CE Certificate

PCAN-PC/104 IPEH-002054/55/56/57 – EC Declaration of Conformity
PEAK-System Technik GmbH

Notes on the CE Symbol CE

The following applies to the PCAN-PC/104 products
IPEH-002054/55/56/57

EC Directive

This product fulfills the requirements of EC directive 2004/108/EG on "Electromagnetic Compatibility" and is designed for the following fields of application as per the CE marking:

Electromagnetic Immunity
DIN EN 55024, Publication date: 2011-09
Information technology equipment, immunity characteristics – Limits and methods of measurement (IEC/CISPR 24:1997, modified + A1:2001 + A2:2003);
German version EN 55024:2010

Electromagnetic Emission
DIN EN 55022, Publication date: 2011-12
Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement (IEC/CISPR 22:2005, modified + A1:2005);
German version EN 55022:2010

Declarations of Conformity

In accordance with the above mentioned EU directives, the EC declarations of conformity and the associated documentation are held at the disposal of the competent authorities at the address below:

PEAK-System Technik GmbH
Mr. Wilhelm
Otto-Roehm-Strasse 69
64293 Darmstadt
Germany

Phone: +49 (0)6151 8173-20
Fax: +49 (0)6151 8173-29
E-mail: info@peak-system.com

Signed this 6th day of February 2013

Appendix B Dimension Drawing

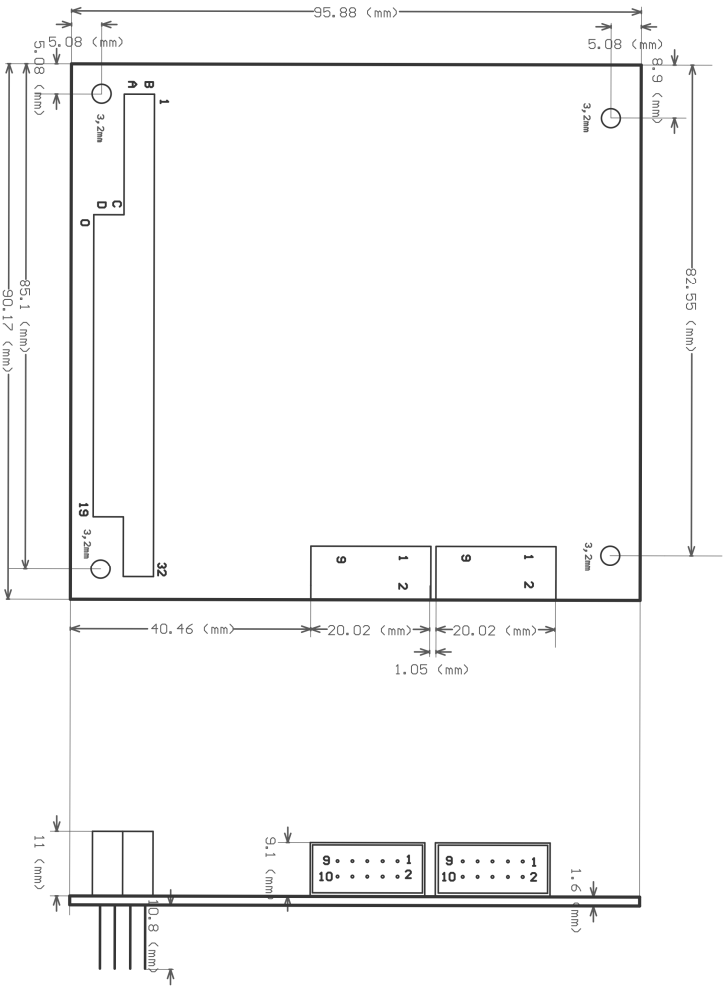

Figure 16: View PCAN-PC/104

The figure does not show the actual size of the product.

Appendix C Quick Reference

Default setting at delivery

CAN Channel	IRQ	I/O Address Range	Comment
1	10	300h – 31Fh	
2	5	320h – 33Fh	Dual Channel model only

Software/Hardware Installation under Windows

Before installing the PCAN-PC/104 card in the PC/104 stack, please setup the corresponding software package from the supplied DVD (with administrator privileges). After switching on the computer enter the BIOS setup. In the PnP table mark the interrupts used by the PCAN-PC/104 card as reserved.

Getting Started under Windows

Run the CAN monitor PCAN-View from the Windows Start menu as a sample application for accessing the PCAN-PC/104 card. For initialization of the card, indicate the parameters (I/O base address, interrupt) and select the CAN connection and the CAN bit rate.

CAN connector (D-Sub, 9-pin)